The applications of micro channel heat exchangers - the practical application in chillers & condensing units

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New legislation to reduce environmental footprint of chillers

**Direct GWP Impact**
- Switch to low GWP refrigerants (F Gas Regulation)
- Reduction in Charge
  - Large portion of charge in chillers is in the heat exchangers
  - Compact low charge heat exchangers

**Indirect GWP Impact**
- Reduce Energy Consumption
  - ASHRAE 90.1 / Ecodesign Europe
    - Variable Speed Drives
    - High Efficiency Compressors/Motors
    - More Efficient Heat Exchangers

High Efficiency Micro Channel Heat Exchangers can help address these challenges
Micro Channel Heat Exchanger

1. Baffle  
2. Tube with microchannels  
3. Header  
4. End cap  
5. Side plate  
6. Fins
Why Micro Channel Heat Exchanger?

**Higher Capacity and Efficiency**
- Lower Condensing Temperature
- Reduced Compressor Power
- Increased Compressor Envelope
- Less Air Pressure Drops (same capacity)

![Image of heat exchanger]

**100% Aluminium**
- Strong mechanical design
- No galvanic corrosion

**70% Less refrigerant charge**
- Up to 70% less for condenser

**100% Aluminium**
- Lower material price volatility
- Easy recycling

**50-70% Weight reduction**
- Savings in transport & installation costs
- Same size-better performance
- Same performance-smaller size
MCHE vs F&T example Air-Cooled Chiller

<table>
<thead>
<tr>
<th></th>
<th>MCHE</th>
<th>F&amp;T</th>
<th>Difference absolute</th>
<th>Difference relative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight, kg</td>
<td>29.7</td>
<td>92.4</td>
<td>62.7</td>
<td>-68%</td>
</tr>
<tr>
<td>Hold-up volume, l</td>
<td>8.1</td>
<td>35.3</td>
<td>27.2</td>
<td>-77%</td>
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<tr>
<td>Space, dm³</td>
<td>62</td>
<td>270</td>
<td>208</td>
<td>-77%</td>
</tr>
<tr>
<td></td>
<td>(25x1200x2050 mm)</td>
<td>(110x1200x2050 mm)</td>
<td></td>
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</tbody>
</table>

Design Conditions:
R410A, Capacity 90 kW, Tc = 50 °C, SC = 5 K
Air temp: 35 °C/RH 50%, Air velocity: 2.6 m/s
MCHE vs. Fin & Tube design

MCHE heat transfer improved by:

- **Reduced refrigerant side hydraulic diameter** = more surface contact
- **Reduced wall & contact resistance** between tubes and fins (no air gaps)
- **Reduced air side flow resistance** on primary heat exchanger surfaces (less wakes & vortex shedding). This also reduces noise.
MCHE Equivalents to Rows of Tube & Fin

- 12mm – 1 row RTPF coil
- 16mm – 1 or 2 row RTPF coil
- 20.6mm – 2 or 3 row RTPF coil
- 25.4mm – 3 or 4 row RTPF coil
- 2 row 16mm – 4 row RTPF coil
- 2 row 20.6mm – 4 or 5 row RTPF coil
- 2 row 25.4mm – 5 or 6 row RTPF coil
Applications

- Chillers
- Residential AC
- Commercial split roof tops
- Condensing units
- Air driers
- Cabinet cooling
- Indoor display
## Product overview - Standard D-range MCHE

### Product Name

<table>
<thead>
<tr>
<th>Product Name</th>
<th>D1000-C</th>
<th>D1100-C</th>
<th>D1200-C</th>
<th>D1300-C</th>
<th>D1400-C</th>
<th>D1500-C</th>
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<tbody>
<tr>
<td>Size, mm</td>
<td>332x300</td>
<td>387x347</td>
<td>462x432</td>
<td>552x517</td>
<td>780x771</td>
<td>974x517</td>
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<tr>
<th>Product Name</th>
<th>D1600-C</th>
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<th>D1800-C</th>
<th>D1900-C</th>
<th>D2000-C</th>
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</thead>
<tbody>
<tr>
<td>Size, mm</td>
<td>1280x623</td>
<td>1324x639</td>
<td>1074x1212</td>
<td>1274x1363</td>
<td>2000x1058</td>
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## MCHE Condenser Ready solutions

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>Size</th>
<th>Commercial AC/Chillers</th>
<th>Condensing units</th>
<th>Air dryers</th>
<th>Cold room</th>
<th>Cabinet cooling</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ΔT= 12 K ν&lt;sub&gt;air&lt;/sub&gt;=2,5 m/s</td>
<td>ΔT= 12 K ν&lt;sub&gt;air&lt;/sub&gt;=3 m/s</td>
<td>ΔT= 15 K ν&lt;sub&gt;air&lt;/sub&gt;=3 m/s</td>
<td>ΔT= 12 K ν&lt;sub&gt;air&lt;/sub&gt;=2,5 m/s</td>
<td>ΔT= 12 K ν&lt;sub&gt;air&lt;/sub&gt;=2,7 m/s</td>
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<td>D1000-C</td>
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<td>385</td>
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<td>3,4</td>
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<td>550</td>
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<td>7,1</td>
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<td>D1400-C</td>
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<td>41,6</td>
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<td>D2000-C</td>
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<td>2000</td>
<td>54,4</td>
<td>62,2</td>
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ARI: Ambient 35°C, HBP (Tevap 5°C), 10 K superheat, 5 K subcooling
CECOMAF: Ambient 32°C, MBP (Tevap -10°C), 10 K superheat, 0 K subcooling
Basic Configurations

Flat coil (condenser)

Folded – two row coil

Bent coil (condenser)
Coil Aspect Ratio

- MCHE is more competitive when the ratio of MPE tube length / header height is high
- Less competitive when MPE tube length / header ratio is low
  - Higher header cost for given face area
  - More flow area blocked by headers
  - More passes / baffles for condenser
Coil Coating

- E-Coat (electrostatically applied epoxy coating) and UV topcoat
- Very thin film black colour
- 100% coverage
- Only 1% heat transfer degradation
- If current application is Cu/Cu FT coil or e-coated FT coil then MCHE requires e-coat as well
- Applications on or near sea side
- Corrosion tested “SWAAT"ASTM G85 A3 for 2400 hours
MCHE coil assembly (Condensing unit)

- Allow for thermal expansion
  - Al thermal expansion coefficient 23E-06 1/K
- Eliminate contact with dissimilar metal
  - Risk of galvanic corrosion
  - Top and Bottom Side Plates – Use rubber/foam shoes or padding
  - Brackets – Use rubber/plastic washers/grommets
Example MCHE coil in Chiller